Detection, Evaluation, and Assignment of Multiple Poly- and Perfluoroalkyl Compounds in Environmental Media from an Industrialized Area of New Jersey:

Work Plan for Soil and Non-Tidal Surface Water Sampling

29 August 2017

Prepared by
NJDEP
Division of Science, Research, and Environmental Health
and Site Remediation and Waste Management Program,
Bureau of Environmental Evaluation and Risk Assessment
and Bureau of Case Management

Background and Objectives

This workplan addresses sample collection procedures for soil and non-tidal surface water. The overall description of this study is found in the "Sample Study Plan" (8/23/2017).

As part of this collaborative research effort, the United States Environmental Protection Agency – National Exposure Research Laboratories in Durham, North Carolina (USEPA-NERL Durham) and Athens, Georgia (USEPA-NERL Athens) will perform analytical services for poly- and perfluoroalkyl substances (PFAS) in surface water and soil samples respectively. Soil and surface water samples will be collected by the NJDEP sampling contractor - Handex Consulting and Remediation (Handex), with soil background sampling conducted by NJDEP-Division of Science, Research, and Environmental Health (DSREH).

Soil Sampling

Excluding field QA/QC samples, there are 28 soil samples to be collected from 24 locations. At each of the 24 sample locations, a shallow soil sample shall be collected. At 4 of the 24 sample locations listed in Table 4 in the Sample Study Plan a shallow subsurface soil core sample shall be collected. There are 2 background soil sample locations (2 of 24 locations) outside the study area (Echo Lake and Cadwalader Park) that are not known to be subject to a direct discharge of PFAS. At the 2 background soil sample locations, only a shallow soil sample shall be collected. All sample locations and sample types are listed on Tables 3 and 4 and shown on Figures 3 and 4 in the Sample Study Plan.

All soil samples, except the 2 soil background locations shall be collected by Handex. The Echo Lake and Cadwalader Park background locations shall be sampled by personnel from DSREH. It is estimated that all soil samples can be collected within 3 to 5 days over 2 consecutive weeks.

Collect all field QC samples (field duplicates and sand field blanks) as described in the Field QC Samples section of this work plan. The attached field sample collection form (or equivalent) shall be completed for each sampling location.

Shallow Soil Samples

One shallow soil sample shall consist of soil removed at 3 subsample locations within about a 1-meter area. The 3 subsamples shall be about equidistant from each other in a short transect or equilateral triangle and shall be collected from about 0 to 6 inches below ground surface after removing the surface vegetation.

Shallow soil samples shall be collected using a dedicated, decontaminated stainless steel trowel (one trowel can be used for all three sub-samples at each location). Where sod is present, carefully remove and set aside before sampling, although some root material may be included in the sample. Soils from the 0-6" sample interval shall be mixed in the hole and then an equal amount from each subsample location transferred to a 500-ml, wide-mouth HDPE sample bottle or a new 1-quart Ziploc HDPE plastic bag filled about halfway. Each soil sample will be homogenized in the USEPA Athens laboratory prior to analysis.

If excessive soil or mud remains on the outside of the sample bottle, the bottles should be rinsed with clean water prior to placement in the sample coolers. If HDPE plastic bags are used for the soil samples, each bag shall be placed inside another bag (double-bagged), so the plastic bags should not need cleaning after filling, other than brushing off loose soil.

Soil Core Samples

The soil core samples shall be collected from the same 1-meter area as the shallow soil samples. Collect each soil core sample from one of the shallow soil subsample locations using a dedicated, precleaned bucket auger or other appropriate soil sample collection device from the 12-18 inch depth interval. Fill the 500-ml, wide-mouth HDPE sample bottle or new Ziploc HDPE plastic bag (double-bagged) with the complete volume of soil collected from the designated 6-inch depth interval directly from the sample collection device. If this is not possible, place the soil from the designated depth interval into a decontaminated stainless-steel bowl or tray and then fill the 500-ml, wide-mouth HDPE sample bottle or new 1-quart Ziploc HDPE plastic bag (double-bagged) with the complete volume of soil collected from the designated 6-inch depth interval. Each soil core sample shall be homogenized in the USEPA Athens laboratory prior to analysis.

Vegetation Samples

Collect specimens of vegetation growing from near/over the soils that are collected at each sample location. Cut the plant material to the ground surface, being careful not to include soil in the vegetation sample, using decontaminated stainless-steel scissors, fill a 1-quart size Ziploc HDPE plastic bag (double-bagged). If the field sampler knows the species/variety of plant, include this in the field notes, if not, photo-document the plant material prior to cutting.

Backfill each sample hole by filling with soil cuttings and replacement topsoil provided by Handex. Where sod was removed, restore the sample location by replacing the sod after filling the soil boring and then water thoroughly.

Non-Tidal Surface Water Grab Sampling

Exclusive of field QA/QC samples, there are 11 surface water (pond) grab samples to be collected from the sample locations listed on Table 5 and shown on Figure 5. There are 11 surface water sample locations chosen to provide a representative set of locations across the study area that are not connected to tidal waterbodies (ponds). Background surface water samples will not be collected. There will be 1 surface water grab sample collected at each location. It is estimated that all surface water samples can be collected within 3 to 5 days over 2 consecutive weeks. Surface water samples shall be collected from the shoreline or other appropriate spot (e.g., bridge) at each waterbody.

Collect each surface water sample directly into a 1-liter HDPE sample bottle by immersing the sample bottle approximately 6 inches below the water surface using a dip sampler or other appropriate sample collection device (e.g., stainless steel or disposable HDPE bailer). If needed due to lack of accessibility, a decontaminated stainless steel or disposable HDPE bailer may be used to collect the water sample and then poured directly into the sample bottle. Fill all sample bottles only to the top of the cylindrical portion of the bottle, leaving the shoulder and the neck empty. This allows room for the nitric acid preservative to be added to the surface water samples. Add one 5-ml ampoule of 35% nitric acid to each surface water sample, seal each container, and shake well to ensure thorough mixing of the acid with the sample. If not added in the field at the time of sample collection, the acid shall be added within 24 hours of sample collection. Include on the label for each surface water sample bottle that the samples are preserved with nitric acid.

Collect all field QC samples (field blank (if bailer is used), field duplicates, trip (bottle) blanks, and spiked blanks) as described in the Field QC Samples section of this work plan. The attached field sample collection form (or equivalent) shall be completed for each sampling location

Sample Locational Information

Each sample location shall have the horizontal and vertical locational attributes determined and recorded using a GPS unit at the time of sample collection. Horizontal data points shall be reported in New Jersey state plane coordinates using the North American Datum of 1983 (NAD 1983), in accordance with the Department's Geographic Mapping and Digital Data Standards found in Appendix A of the General Practice and Procedure rules at N.J.A.C. 7:1D Appendix A, using units of U.S. survey feet. If the locational information is collected in latitude and longitude, convert to New Jersey state plane coordinates. Conversion programs are available at www.nj.gov/dep/srp/hazsite/help/software/. All vertical data points shall be reported as depth below ground surface and in mean sea level using the North American Vertical Datum of 1988 (NAVD 1988) in accordance with the Department's Geographic Mapping and Digital Data Standards found in Appendix A of the General Practice and Procedure rules at N.J.A.C. 7:1D Appendix A.

Sampling QC

All sampling procedures and sample handling shall be conducted to prevent and minimize potential cross-contamination with PFASs. The quality of supplies and consumables used during sample collection and laboratory analysis can affect the quality of the project data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination from PFAS. Sample collection shall be performed in accordance with the Department's *Field Sampling Procedures Manual* (August 2005) and the Handex QAPP as modified for emerging contaminants by this work plan and the QA/QC precautions for PFAS.

Handex shall procure 500-ml HDPE sample bottles with unlined caps or 1-quart size Ziploc HDPE plastic bags (sufficient quantity to allow for double bagging) for the soil samples, 1-liter HDPE sample bottles with unlined caps for the surface water samples, and the 5-ml nitric acid preservative (5 ml ampoules of 35% nitric acid from EP Scientific Products, Miami, OK) for the surface water samples. Handex shall provide the empty sample bottles and sampling equipment needed for the background soil sampling to be conducted by DSREH. Handex shall provide documentation from the supplier, if available, that all sample containers are new and unused. All containers shall be visually inspected prior to use and any suspect containers shall be discarded.

Prior to field sampling, Handex will ship labeled, empty QC sample bottles for preparation to each EPA-NERL lab as described below in the "Field QC Samples" section. All applicable field QA/QC samples are to be collected as specified in this work plan.

Sample Bottle Labeling - Sample containers shall be clearly labeled at the time of sampling. Labels shall include the study name, sample number, sampler's initials, analyses to be performed, preservatives added, sample location, and date and time. Sample numbering and identification procedures shall be as follows: PF for PFAS Study; NSW for nontidal surface water, SS for surface soil, SC for soil core, and VG for vegetation; and xxx for three-digit sample number (i.e., PFNSW001 thru PFNSW014, PFSS001 thru PFSS028, PFSC001 thru PFSC0004, and PFVG001 thru PFVG0028). The sample identification and numbering for field QC samples shall be as follows: DUP, SB, FB and TB, respectively, shall be used instead of the three-digit sample number followed by a sequential

number to identify the field duplicate samples (e.g., PFNSWDUP1), spiked blanks (e.g., PFNSWSB1), field blanks (e.g., PFNSWFB1), and trip blanks (e.g., PFSSTB1).

Each labeled sample container after cleaning shall be put into a HDPE plastic Ziploc bag (if a large enough size bag can be found for the 1-liter containers), sealed, and placed in a cooler with appropriate non-PFAS-containing packing material, if needed, to secure the sample containers inside the cooler. A chain-of-custody (CoC) form shall be completed and included with the samples. The preserved surface water samples shall be stored at room temperature in a secure location prior to shipment to the USEPA Durham laboratory with the soil samples stored under refrigeration or with ice and replenished as needed. When the coolers are full or ready for shipment, the CoC form shall be placed into a HDPE plastic Ziploc bag, sealed, and taped to the inside lid of the cooler. Each cooler shall be sealed with two CoC seals, one each on the front and side of the cooler. Labels indicating "This End Up*"* with an arrow and "Fragile" shall be attached to each cooler.

Handex shall use the same sampling team leader for each location to minimize sampling error. Sampling shall be scheduled so samples **arrive** at the two USEPA laboratories no later than Friday the week sampling is completed. If samples will be held in the field to accommodate field schedules, samples shall be properly preserved or refrigerated/iced and held under chain of custody. Handex shall make all cooler and sample shipping arrangements directly with the USEPA laboratories.

Handex shall provide all sampling equipment: one dedicated trowel for each soil sample location (i.e., at least 28 trowels), one dedicated bucket auger for each core soil sample location, one funnel for each sand field blank location (3 total), stainless steel scissors for vegetation samples, and dip sampler (or stainless steel or HDPE disposable bailers if needed) for surface water samples. All sample collection equipment (e.g., bucket augers) shall be precleaned in accordance with the FSPM for collection of samples for organics analysis and wrapped securely in HDPE plastic (plastic garbage or Ziploc bags) prior to transport to the field for sample collection. Stainless steel scissors for vegetation sampling (and stainless steel bailers, if disposable HDPE bailers cannot be provided for each sample location) shall be field decontaminated between each location using a detergent and tap water wash, a distilled/deionized water rinse, and cleaning with methanol wipes (scissors) or rinsed with methanol (bailers).

The coolers shall be clearly labeled (i.e., name of study, time and date container was sealed, person sealing the cooler, and Handex name and address) for positive identification. These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24). The coolers containing the surface water samples shall be shipped overnight to the USEPA Durham laboratory via FedEx at ambient temperature without adding water ice or blue ice. The coolers containing the soil samples shall be shipped overnight to the USEPA Athens laboratory via FedEx including double-bagged water ice (to prevent melt water from coming in contact with sample bottles). After the samples have been received by the USEPA laboratories, they shall be stored in accordance with USEPA laboratory requirements prior to analysis. USEPA shall ship the empty coolers back to Handex using the FedEx shipping account information to be provided by Handex.

Because PFASs are also found in numerous everyday items, the following special precautions shall be taken during all sampling activities:

- No use of Teflon®-containing or similar materials (e.g., Teflon® tubing, bailers, tape, sample jar lid liners, plumbing paste).
- No use of cosmetics, hand cream, moisturizers, sunscreens, insect repellants or related products containing "floor" in ingredients. Any insect repellant or sunscreen used during the sampling events shall be applied downwind and well away from sample containers and sample collection equipment with hands washed prior to sampling.
- No coated Tyvek® or similar clothing or waterproof boots shall be worn.
- Clothes treated with stain- or rain-resistant coatings shall be avoided or go through several washings prior to use onsite.
- Use wet weather gear made with polyurethane and PVC only.
- Clothes worn for sampling should have been washed or dried without fabric softener.
- No Post-It®, waterproof field books or similar paper shall be brought onsite.
- No fast food wrappers, disposable cups, or microwave popcorn shall be brought onsite.
- If any such materials are handled, field personnel shall wash their hands thoroughly with soap and water prior to any sampling activities.
- No use of chemical (blue) ice packs or aluminum foil is allowed.
- Nitrile gloves shall be worn and changed between each sample matrix collected and each sample location to minimize the possibility of cross-contamination between sample matrices and sampling locations.
- Sharpies or similar marking pens shall not be used on the sample containers or labels.

Field QC Samples

Prior to sampling, Handex will ship empty bottles intended for preparation of QC samples in coolers to both USEPA-NERL laboratories in Athens, GA and Durham, NC via FedEx. Handex will pre-label empty QC sample bottles prior to shipment as specified in the "Sample Bottle Labeling" section above. USEPA-NERL (Durham, NC) will prepare trip (bottle) blanks, field blanks and spiked blanks for surface water sampling and USEPA-NERL (Athens, GA) will prepare sand field blanks for soil sampling. Each USEPA-NERL lab will return ship prepared QC blanks to Handex just prior to sampling, using the FedEx shipping account information to be provided by Handex.

Field Duplicates: Collect soil and surface water field duplicate samples at a frequency of 1 field duplicate for every 10 samples. As 11 surface water and 28 soil samples will be collected, 2 field duplicates shall be collected for surface water and 3 field duplicates shall be collected for soil. For the soil field duplicates, one of the field duplicates shall be collected at the Echo Lake or Cadwalader Park background sample location, one at soil sample location #1 (1425 Metropolitan Ave. athletic facility), and one at a randomly selected non-background soil sample location. For the surface water field duplicates, collect one on separate days at any sample location.

Surface Water Trip Blanks (Bottle Blanks): For the surface water samples, trip (bottle) blanks will be included at a frequency of 1 trip blank for every 10 samples. As sampling is estimated to be completed within 2 consecutive weeks with only 1 shipment of samples to the USEPA laboratories, only 1 trip blank should be needed and labeled as PFNSWTB.

Surface Water Spike Blanks: For the non-tidal surface water samples, spike blanks will be included at a frequency of 1 spike blank for every 10 samples. Handex shall ship 2 empty 1-liter sample bottles labeled as described below to USEPA-NERL Durham laboratory where the spike blanks will be prepared and return shipped to Handex in the sample cooler along with the surface water trip (bottle)

blanks and field blanks so they may travel unopened with the samples and duplicates in the field. As 11 surface water samples will be collected, 2 spiked blanks shall be included for this study and labeled as PFNSWSB1 and PFNSWSB2.

Surface Water Field Blanks (if needed): If bailers are used to facilitate collection of a surface water samples, dedicated decontaminated stainless steel or disposable HDPE bailers shall be used. An aqueous field blank must be collected at a frequency of 1 for every 10 samples and performed in accordance with the FSPM. Handex shall estimate the total number of bailers needed, i.e., aqueous field blanks to be collected and send the appropriate number of 1-liter HDPE bottle(s) to the USEPA Durham laboratory for filling with reagent free water along with the other QC sample bottles described above. If no bailers are used, surface water samples are to be collected directly into precleaned sample bottles, so there is no need to collect a traditional aqueous field blank

Sand Field Blanks: Collect the sand field blanks by pouring the sand from the container received from the USEPA-NERL Athens laboratory over the trowel or other sample collection device and collecting the sand into an empty sample bottle or 1-quart Ziploc plastic bag. If necessary, a precleaned funnel shall be used to direct the sand into the HDPE sample bottle or Ziploc bag.

For soil samples, sand field blanks will be collected at a frequency of 1 sand field blank for every 10 samples. Three sand field blanks shall be collected as follows: one sand filed blank shall be collected on the first day of sampling and one on the last day of sampling at the study sites, with 1 additional sand field blank collected at one of the background locations.

Methanol Sample: Handex shall ship one sample of the methanol that is used to clean the surface water and soil sampling equipment to each of the USEPA-NERL laboratories .

Laboratory Analysis and Reporting

NJDEP shall be contacted by Handex or USEPA for any issues that come up with sample collection or analysis, including QA/QC issues.

All surface water samples will be analyzed for PFAS at the USEPA's National Exposure Research Laboratory (NERL) in Durham, North Carolina, in accordance with their analytical SOP EMAB 114.0 (Attachment B) with the results submitted to the NJDEP contact(s). All soil samples will be analyzed for PFAS at the USEPA's National Exposure Research Laboratory (NERL) in Athens, Georgia, in accordance with their analytical method described in Rankin et al. (2016).

Handex shall submit to Erica Bergman of the NJDEP a sample collection summary report within 14 calendar days after completion of all sampling. The summary report shall include, at a minimum, the dates of sampling, weather conditions, sample collection equipment and methods used, observations of surface water and soil characteristics, photos of each sample location and sample collected, list of sample IDs, GPS coordinates, and all other information deemed of importance. The attached field sampling form or Handex equivalent shall be completed for each sampling location and included as an attachment in the summary report.

Laboratory Contact and Shipping Information

Andrew Lindstrom or Mark Strynar
USEPA NERL Chemical Services Center
109 TW Alexander Drive

Building “E” Loading Dock, Rm E-178
Durham, NC 27709
Phone: 919-541-0551 (Andrew Lindstrom)
Lindstrom.Andrew@epa.gov

John Washington
USEPA National Exposure Research Laboratory
960 College Station Road
Athens, GA 30605
Phone: 706 355 8227
Washington.John@epa.gov

NJDEP Contact Information

Erica Bergman
NJDEP
Site Remediation and Waste Management Program
Bureau of Case Management
erica.bergman@dep.nj.gov
609-292-7406, and

Sandra Goodrow
NJDEP
Division of Science, Research, and Environmental Health
sandra.goodrow@dep.nj.gov
609-984-9556

Field Sample Collection Form
NJDEP/EPA-NERL PFAS Sampling Study
Gloucester and Salem Counties
Fall 2017

1. Date: Time:
2. Sampler's Name(s):
3. Sampling Location:
4. Sample ID(s):
5. GPS location taken? Coordinates:
6. Tidal Stage (if tidal site):
7. Sample Type(s) (e.g. surficial or core soils, surface water (i.e., pond or tidal), sediments):
8. General weather conditions (include notable past weather conditions that may impact sample):
9. Did you take required pictures of site? How many? How to ID pics?
10. Equipment and Methods Used:
11. Any deviations to sampling location or methodologies necessary?
12. Any notable conditions present at site (observations of surface water, sediments or soils)?
13. Details of preservatives used:
14. Details of blanks taken at this site:
15. Rough sketch of site including approximate sampling location:

16. Name/Signature of Lead Sampler:_____